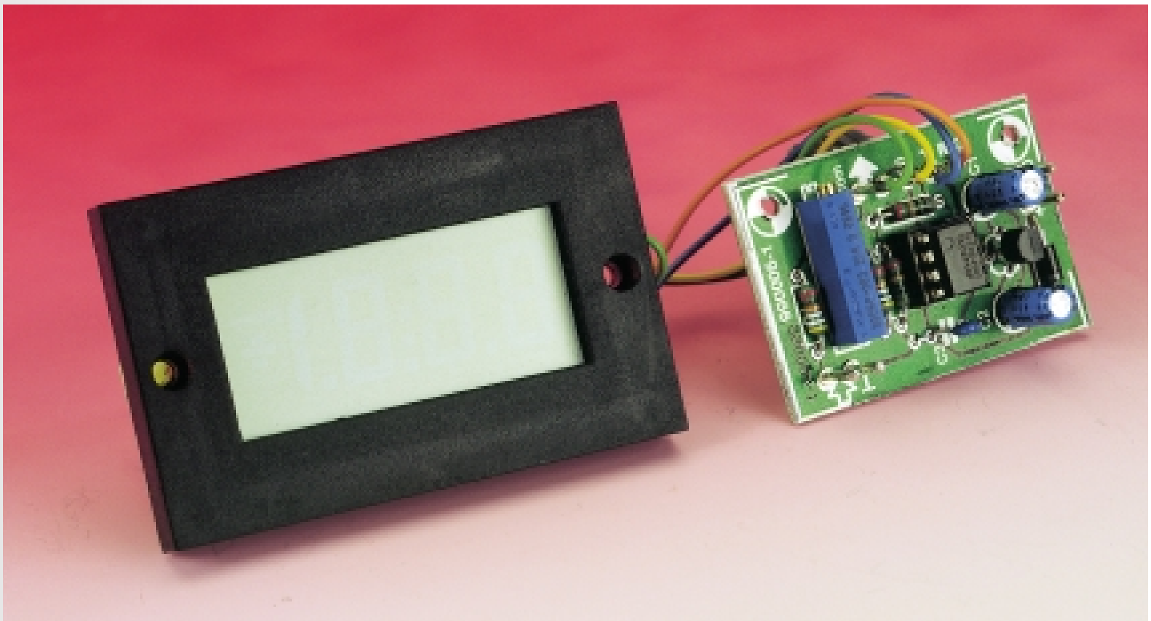
power for panel meter

without auxiliary battery



Most meter modules using a liquid-crystal display (LCD) and some using a light-emitting-diode (LED) display need a power source that is isolated from the measurand. In practice, this normally means that a separate battery has to be used. This is cumbersome and can be avoided with the circuit described in this article.

Design by G. Lindner

INTRODUCTION

It is an annoying fact that when it is desired to fit a digital panel meter to a certain equipment, the power for this often cannot be drawn from the supply for that equipment. This is not always so, but it certainly is in the case of meters based on the popular ICL7106 and ICL7107. This means that a separate supply has to be provided for the meter whose earth (common return) is isolated from that of the equipment supply.

A simple solution to this problem is the present simple auxiliary circuit, which is a variant of the d.c shifter used in the 'capacitance meter' published in our November 1994 issue. The circuit can be used with any digital voltage module based on an ICL7106. It is based on the shifting of the reference level of the input signal.

DESIGN CONSIDERATIONS

The reason that the earth (common return) of the meter must be isolated from that of the measurand (quantity to be measured) is clear from **Figure 1**. In this, the meter is is treated as a black box with two inputs for the supply lines and two for the measurand. The terminal 'low in' is at the potential of the supply lines less 2.8 V. This means that if the meter and the signal source are to be linked to the same earth, the value of the measurand has to be raised by U_S–2.8 (V).

This is achieved with the aid of the popular non-inverting adder circuit in **Figure 2**. In this, the operational amplifier (op amp) will try to equalize the

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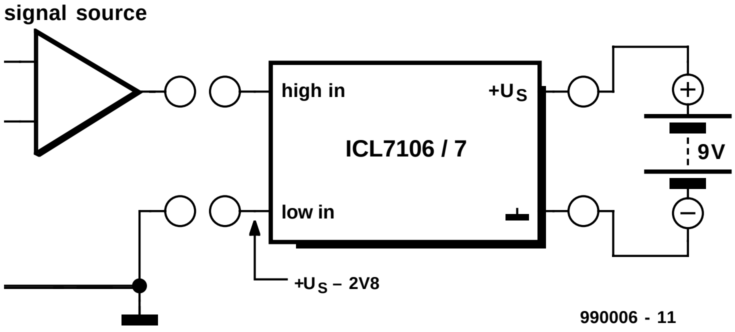

Figure 1. The potential at the ‘low in’ terminal of the meter is U_S–2.8 V, which means that that at the ‘high in’ terminal must be raised by an identical value.

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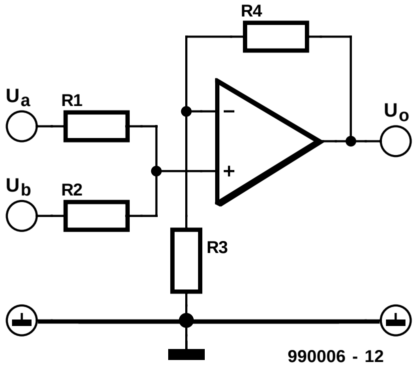

Figure 2. This circuit ensures that the ‘low in’ signal is added to the signal from the source.

levels at its two inputs. When $R_2/R_1 = R_4/R_3 = 1$, the output voltage will assume a level of $U_O = U_a + U_b$. The measurand is linked to terminal *a*. When output U_O is linked to the ‘high in’ terminal of the meter and input U_b to terminal ‘low in’, the desired shift is achieved, whereupon the return lines of the power supply and measurand can be connected to the same earth.

CIRCUIT DESCRIPTION

The diagram of the auxiliary circuit is shown in **Figure 3**, which is basically the same as that in Figure 2, with the meter terminals and a preset potentiometer, P_1, added.

The preset is essential, since it cannot be assumed that the transfer ratio of the input signal is 1:1. This is because in practice all sorts of deviation occur owing to tolerances, the output impedance of the signal source, and the offset of the op amp. All these can be compensated with P_1, provided that the output impedance of the signal source ≤ 2.5 kΩ. If this is not so (which in practice will be seldom), the value of R_1 has to be altered slightly. Note that the compensation provided with P_1 is dependent on the supply voltage. This dependency is such that the meter indication varies over a wide range in direct proportion to supply voltage fluctuations. This is because the offset of the op amp is also compensated; if there were no offset, the meter indication would be independent of the supply voltage. All this is of not much importance, however, as long as the supply voltage is properly regulated.

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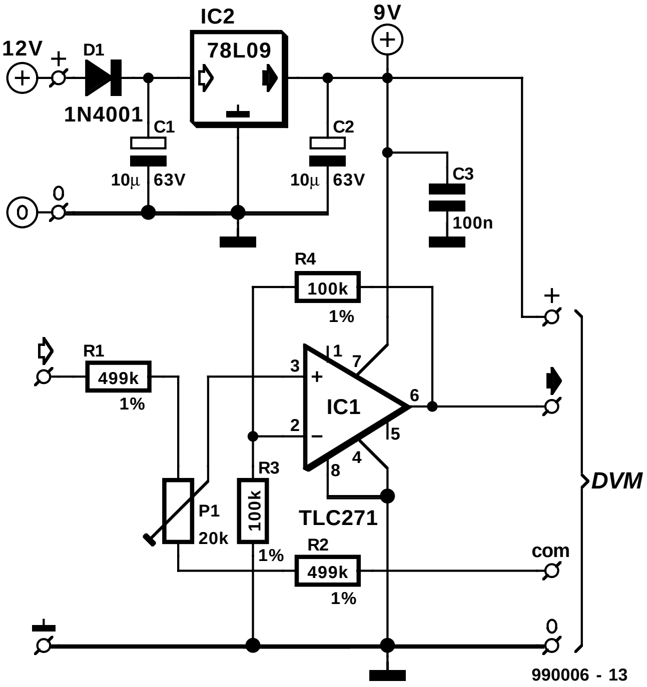

Figure 3. The diagram of the auxiliary circuit complete with regulator. The regulator is essential since the compensation set with P_1 is dependent on the supply voltage.

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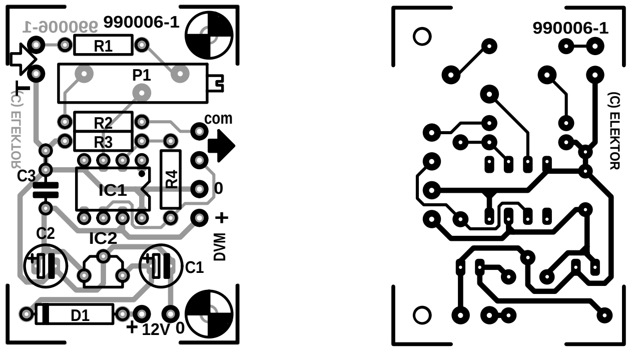


Figure 4. Printed-circuit board for the auxiliary circuit (not available ready made).

Parts list

Resistors:

R_1, R_2 = 499 kΩ, 1%

R_3, R_4 = 100 kΩ, 1%

P_1 = multiturn 20 kΩ preset potentiometer, horizontal model

Capacitors:

C_1, C_2 = 10 µF, 63 V, radial

C_3 = 0.1 µF, ceramic

Semiconductors:

D_1 = 1N4001

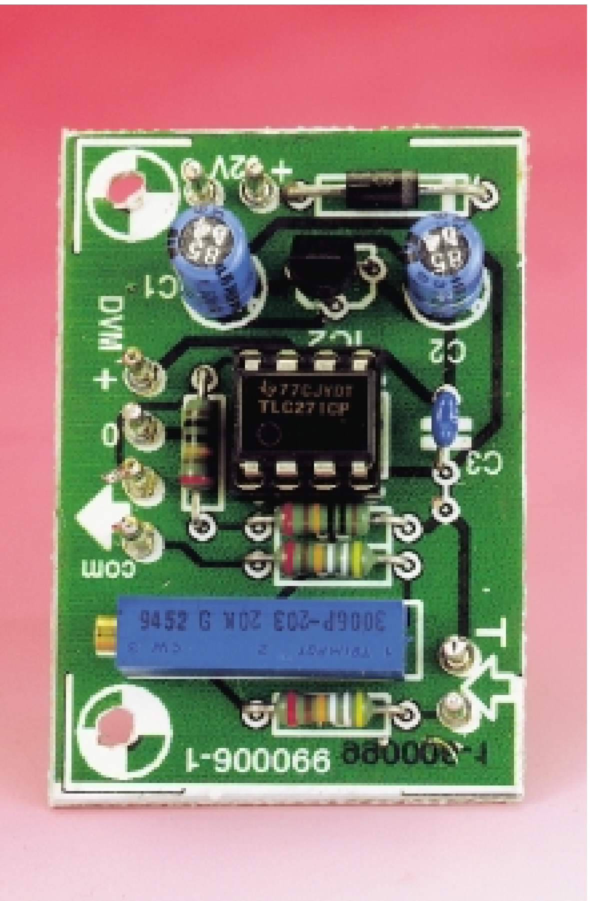
Integrated circuits:

IC_1 = TLC271CP

IC_2 = 78L09

Miscellaneous:

Meter module based on ICL7106



Since the current drawn by the ICL7106 is tiny, this stabilization may be effected simply with a zener diode and series resistor. However, to avoid any risks, the circuit in Figure 3 uses a popular three-pin regulator. Diode D_1 protects the circuit against inadvertent wrong polarity of the input voltage.

CONSTRUCTION

The circuit is best built on the printed-circuit board in **Figure 4**, which is, however, not available ready-made.

The size of the board enables the circuit to be built into most equipment, and in many cases to be made into 'a sandwich' with the meter.

If there is a suitable supply (9–15 V) available in the signal source, regulator IC_2 may be replaced by a wire bridge.

SETTING UP

- Link the auxiliary circuit to the meter and connect the combination to the output of the signal source.
- Set the output voltage of the signal source to 0 V.
- Adjust P_1 until the meter reads exactly 0 V: all deviations are then nullified.
- Set the signal source to the highest possible output and adjust its meter output until the meter displays the correct level. It is assumed that the signal source has an integral potential divider for this purpose; if it has not, it has be added – see **Figure 5**. The values of the resistors must be chosen so that at maximum output of the signal source the maximum input potential of the meter (200 mV) is not exceeded.
- Since the output impedance of the signal source varies slightly when the potential divider is set, it needs to be checked whether the compensation set with P_1 is still correct. This means setting the output of the signal source to 0 V again and readjusting P_1.
- Repeat the setting up procedure a couple of times until a satisfactory result is obtained.

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Figure 5. A potential divider enables the output of the signal source to be equated with the correct meter reading.

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